IN THE UNITED STATES PATENT & TRADEMARK OFFICE

SUBJECT:
Serial #: 09/729,154
File Date: Dec. 4, 2000
Inventor: Chen-Hua Yu and Syun-Ming Jang
Examiner: Ron Pompey
Art Unit: 2812
Title: A SHALLOW TRENCH ISOLATION PROCESS FOR REDUCED JUNCTION LEAKAGE

DECLARATION UNDER 37 CFR 1.131

Honorable Commissioner of Patents & Trademarks

Washington, D.C. 20231

Sir:

I, Chen-Hua Yu and Syun-Ming Jang, hereby state:

1. I am a co-inventor of Claims 23-33 of the above-identified patent application.

2. Prior to October 21, 1998, we conceived of the idea for "A Shallow Trench Isolation Process For Reduced Junction Leakage", as described and claimed in our application, and a copy of the invention disclosure describing our invention entered the United States of America before October 21, 1998. The invention disclosure including drawings shows our invention as claimed in Claims 23-33. The invention disclosure is attached as Exhibit A.

3. George O. Saile & Associates forwarded to us a Novelty Search report describing the results of a search for related prior art dated February 12, 1998. The Search Report is attached as Exhibit B

4. George O. Saile & Associates forwarded to us a draft copy of the patent application along with a letter dated July 2, 1998 (Exhibit C). This letter shows due diligence from prior to the effective date of the reference (October 21, 1998) to the subsequent filing of the patent application as detailed hereinafter.

5. The Invention was constructively reduced to practice by filing of patent application serial number 09/192,521 on November 16, 1998.

6. The above-identified patent application is a divisional application of TS97-510, serial number 09/192,521, filed November 16, 1998, now U.S. Patent 6,225,171 issued May 1, 2001.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Chen-Hua Yu — Date 8/12/03

Syun-Ming Jang — Date 8/12/03

Exhibit A

Steve

TSMC INVENTION DISCLOSURE PAGE 1 OF 1 TSMC CONFIDENTIAL (WHEN COMPLETED)

FULL NAME(S) OF INVENTOR(S)	EMPLOYEE NO.	DEPARTMENT	TEL. NO.	FOR USE BY INTELLECTUAL PROPERTY LAW DISCLOSURE NO. TSMC-1-99-510
C. H. Yu	944620	2331	3450	I.P. WHEN RECEIVED (TIME STAMP) [redacted]
S.M. Jang	933816	2331	3458	

Simon

TITLE OF INVENTION –
A Novel Shallow-Trench-Isolation Process for Reduced Junction Leakage

BACKGROUND INFORMATION -- CURRENT PRACTICE AND DISADVANTAGES
1. Pre-Ti or pre-Co deposition clean in HF chemistry will clear residual oxide on source/drain but will also reduce the thickness of the oxide in shallow-trench-isolation.
2. The excessive oxide removal in STI will cause junction leakage after TiSix or CoSix is formed.
3. Boron in p+ S/D will diffuse through STI liner oxide so that its local concentration at the interface is lower to create more junction leakage.

MAIN POINTS OF CLAIM (PLEASE LIST ITEM BY ITEM)
1. Use nitrogen-doped silicon oxide for liner oxide before STI gap fill. Or form nitrided Si surface before SiO_2 liner oxide is grown.
2. For nitrogen-doped oxide, the wet etch rate of it is lower than regular oxide and less sidewall oxide loss takes place during pre-Ti wet etch.
3. The nitrogen can also stop boron from diffusion from P+ S/D into liner oxide to maintain boron concentration in the S/D.

PROBLEM SOLVED OR IMPROVEMENTS OBTAINED BY THIS INVENTION (PLEASE LIST ITEM BY ITEM)
1. Reduce junction leakage at the boundary of STI edge for self-aligned $TiSi_x$ or $CoSi_x$.
2. Avoid the dip from happening at the interface between trench sidewall and STI gap-fill oxide.

KEYWORD SEARCH FOR PATENT/LITERATURES
Nitrided Oxide, Nitrogen-doped Oxide, Titanium Silicide, Junction Leakage

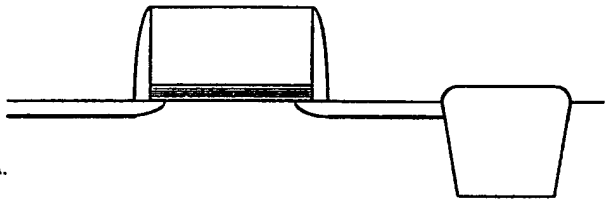
PATENT/LITERATURES SEARCH RESULT (PLEASE SPECIFY SIMILAR PATENT NO. AND LITERATURE CITATION)

Not patented before.

DETAILED DESCRIPTION OF INVENTION – (CONTINUED NEXT PAGE)

The process flow of this improved structure is listed as following:

1. STI etching.
2. ***Liner oxide thermal growth.*** The growth can start with a nitrogen treatment (NH_3, NO, N_2O, N_2, etc.) on Si trench sidewall or we can have the nitrogen incorporated into thermal oxide during the growth.
3. Deposit gap fill layer.(eg. SACVD or HDPCVD oxide)
4. High temperature annealing.(800 - 1200C)
5. CMP of the BPSG.
6. Continue on processing for transistor engineering.
7. Before Ti or Co saliciation, do diluted HF (eg. 50:1 BOE) etch.
8. Deposit Ti or Co and optional TiN, do RTA, selective etch and second RTA.
9. Continue on back end processing.



WITNESSES : THE TWO WITNESSES WHOSE SIGNATURES APPEAR BELOW HAVE READ AND UNDERSTAND THIS ENTIRE INVENTION DISCLOSURE.	DISCLOSURE SUBMITTED BY	
	INVENTOR'S SIGNATURE DATE [redacted]	INVENTOR'S SIGNATURE DATE [redacted]
SIGNATURE OF WITNESS DATE [redacted]	INVENTOR'S SIGNATURE DATE	INVENTOR'S SIGNATURE DATE
SIGNATURE OF WITNESS DATE [redacted]		

Exhibit B

February 12, 1998

20 McIntosh Drive
Poughkeepsie, N.Y. 12603

Fax .914 4712064

To: D.C. Lin
Patent Dept.
TSMC
cc: Tessie Wang

From: George O. Saile

Subject: Novelty Search at the US Patent Office - TSMC1-97-510 Inventor Names: C.H.Yu, S.M.Jang - Title: A NEW SHALLOW-TRENCH-ISOLATION PROCESS.

The following is the result of my Prior Art Subject search at the US Patent Office.

The invention shows forming an Optional oxide liner with a Nitride treatment, forming gap filler layer of BPSG and annealing. Related to TSMC97-486 AND TSMC97-488

US 5,208,179(Okazawa) shows a trench filled with BPSG.

US 5447884 (Fahey): *Shallow trench isolation with thin nitride liner* - shows A method of forming shallow trench isolation with a nitride liner layer for devices in integrated circuits.

US 5492858 (Bose) : Shallow trench isolation process for high aspect ratio trenches - shows a method of forming STI with SiN liners and an oxide anneal. The etched trenches are first coated with a silicon nitride protective liner before the trenches and active area mesas are conformally coated with a layer of silicon oxide. The conformal oxide then is steam annealed to densify the conformal oxide, and then the surface of the silicon wafer is etched and polished back down to the tops of the active area mesas, to form a substantially planar surface.

US 5112772 (Wilson) Method of fabricating a trench structure - shows a method of forming a STI using an oxide liner.

US 5,316,965(Philipossian et al.) shows a FOX that is I/I with N_2 and annealed.

In summary, the patents appear close to the invention, but no one patent shows the exact details of the invention. I shall begin preparation of the invention, but it should be understood that there is a question of obviousness and the patent office may object to this invention. If you wish you can order the reference patents and let the inventors review them, but it is not necessary.

With best regards,

George O. Saile

Exhibit C

July 2, 1998

20 McIntosh Drive
Poughkeepsie, N.Y. 12603

FAX: 914 4712064

To: Tessie Wang
Patent Department
TSMC

From: George O. Saile

Subject: Patent Application Reference TS97-510
Inventors: C.H. YU AND S.M JANG

The subject Patent Application is now ready for the Inventor's signature on the (1) Declaration and Power of Attorney, and (2) Assignment of Invention forms. **Please have the Inventors sign their complete name and in order of first name first then family name.** These forms are enclosed with a copy of the drawings, specification and claims of the Patent Application. The drawings are informal at this time, but will be made formal for filing with the Patent Office and a copy of them will be sent to you.

Do not make any changes in the Patent Application. But do note any typographical, etc. errors, and let me know what they are on a separate sheet of paper.

Please fill in the required information on these forms and have the Inventor sign them. Also make copies of these papers for your own files as needed. Please send the original Patent Application and the signed forms to me by EXPRESS MAIL DELIVERY. It is important to file patent applications as quickly as possible.

Regards,

George O. Saile